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Independent directors and firm innovation: the moderating role of gender and nationality diversity

Independent directors and firm innovation

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Abstract

Purpose – Although the literature on corporate governance and firm innovation finds that board independence is important, **the authors** propose that the presence of independent directors alone is not enough to explain their impact on firm innovation. **The** study analyses if gender and nationality diversity among independent directors may affect the relationship between board independence and firm innovation.

Design/methodology/approach – A panel data on a sample of 124 Spanish listed companies for the period 2008–2019 **were** used to test **the** hypotheses.

Findings – Results suggest that independent directors have a negative effect on firm innovation, measured as number of patents, but when there are high levels of gender and nationality diversity among such directors, this negative effect may be mitigated.

Originality/value – Considering that firm innovation is a complex process associated with decision-making and that board independence itself may be insufficient, **the authors** go a step further and delve into the characteristics of independent directors. As far as **the authors** know, **the authors** provide the first theoretical and empirical study to consider independent director diversity as a moderating variable between board independence and firm innovation. In addition, **the authors** contribute to the debate on the role of independent directors in firm innovation, and **the** results may also serve as a guideline for policymakers and firms for structuring boards that are pro-innovation.

Keywords Board independence, Gender diversity, Nationality diversity, Firm innovation

Paper type Research paper

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1. Introduction

The decision-making process within a company to determine the right elements for a successful innovation strategy is important, mainly because the results of innovation are uncertain and in most cases are reflected in the long term (Baysinger *et al.*, 1991). Additionally, implementing firm innovation as a strategy depends not only on large amounts of investment and a reasonable time to obtain results, but also on knowing how to identify the most suitable projects, recognizing potential business opportunities, knowing the market and consumers in order to generate new products and services, and so on (Teece *et al.*, 2016). This complexity may increase risk aversion among decision-makers and may even discourage managers from investing in research and development projects because they may prefer to invest in short-term projects which will bring earlier compensation (Zona, 2016).

The literature on corporate governance has highlighted the importance of the board of directors, especially of independent members, in the decision-making process as a mechanism that may favour the alignment of interests between the shareholders and the management team as well as long-term business growth (Ahuja *et al.*, 2008; Fama and Jensen, 1983; Hill and Snell, 1988). Most studies based on agency theory (Fama, 1980; Fama and Jensen, 1983) argue that the criterion of independent directors can be more assertive when deciding on innovation projects (Balsmeier *et al.*, 2017; Garcia Osmá, 2008; Lu and Wang, 2018) as they do not have additional relationships with the firm that might generate conflicts of interest. The effect of control by independent directors may be even more effective when other governance



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mechanisms are not sufficiently developed, such as when ownership is dispersed because shareholders are not able to accumulate sufficient power to supervise their managers directly (Gutiérrez and Sáez, 2013). In addition, the presence of independent directors may become a source of information and consultation that may improve decision-making concerning innovation, especially considering that the role of independent directors in firm innovation goes beyond control and supervision.

By contrast, other studies claim that, since the links between independent directors and the company are not strong, independent directors may not be sufficiently motivated to increase firm innovation and their presence might even be detrimental for innovation activities (Blibech and Berraies, 2018; Tai *et al.*, 2018; Takahiro, 2015). The existence of excessive control by independent directors may also have negative effects on managers' behaviour by making them reluctant to trust the board (Guldiken and Darendeli, 2016). As a result, the flow of valuable information for decision-making between the board and managers may be affected. In line with these contradictory theoretical arguments about the relationship between independent directors and firm innovation, previous empirical evidence is also inconclusive, with both positive (e.g. Attia *et al.*, 2021; Berezinets *et al.*, 2019; Fu, 2019) and negative evidence (e.g. AlHares, 2020; Blibech and Berraies, 2018; Gonzales-Bustos *et al.*, 2020).

In this context, our paper aims to study in depth this relationship between independent directors and firm innovation from a different perspective. We propose that the key to a better understanding of the effect of independent directors on firm innovation lies not only in their actual presence on the board, but also in their specific characteristics at individual level. In other words, we propose that independent directors' diversity may moderate the above relationship.

Although the literature highlights various aspects of diversity, this study focuses on gender diversity and nationality diversity for several reasons. Gender and racial diversity within organizations were among the first diversities studied in the literature (Roberson *et al.*, 2017). Today, it is also considered that cultural diversity may be determined not so much by race alone, but also by country of origin, that is, nationality (van Veen *et al.*, 2014). Additionally, board gender and nationality diversity has also recently become a key global political and social issue for both companies and countries (Gyapong *et al.*, 2016; Khan and Abdul Subhan, 2019; Mahadeo *et al.*, 2012; Sarhan *et al.*, 2019; Zaid *et al.*, 2020). Therefore, some countries have established legislation to increase the inclusion of minorities on boards of directors based on ethical motivations (equality and equity), but also because of their economic benefits (Belkacemi *et al.*, 2021; Terjesen *et al.*, 2016).

In addition, we follow the call made by previous studies suggesting that gender and nationality diversity should remain the focus for new research. For example, Ruigrok *et al.* (2007, p. 555) suggest in their paper that "*future research needs to address how the interactions between directors' gender and nationality diversity and independence influence the actual contributions and board role performance of directors in the boardroom*". A board member of different gender and/or nationality can bring not only different perspectives, skills, and knowledge, but also different values, cognitive schemas, personality traits, norms and understanding that are relevant to their role as directors (Kaczmarek and Nyuur, 2021; Ruigrok *et al.*, 2007). Such diversity enriches the diversity of criteria when making decisions on, among other topics, innovation (Griffin *et al.*, 2021; Makkonen *et al.*, 2018). Furthermore, the presence of a high degree of gender and cultural diversity can effectively weaken social barriers and thus improve the working environment for decision-making (Schopohl *et al.*, 2021).

In particular, gender diversity is one of the diversities within the board that has been most widely studied in previous literature on board and innovation (Attia *et al.*, 2021; Cumming and Leung, 2021; Khatib *et al.*, 2021; Sánchez-Teba *et al.*, 2021). Moreover, due to the growing

global interest in inclusion and equality (Adams and Ferreira, 2009), the United Nations, for example, in its 2030 Agenda for Sustainable Development, has set as one of its objectives the promotion of gender equality in member countries. Also, several governments have chosen to include gender quotas in their legislation (Terjesen *et al.*, 2009). Regarding nationality diversity, although it has not been extensively studied in previous literature in general or in innovation-related works, it is one of the recommendations for future research. For example, Khatib *et al.* (2021) suggest that future studies should take into account other attributes of diversity to include not only gender, but also ethnic or national diversity, among others, and the interaction between them. In addition, increasing internationalization of organizations in recent years has led to larger numbers of foreign board members in boardrooms. Some companies in origin countries prefer to send their local employees to occupy different positions in their foreign subsidiaries to ensure an adequate transfer of knowledge and organizational culture (Cao *et al.*, 2019; Zulkifly *et al.*, 2019). Others tend to employ foreigners from more industrialized countries because they have more experience, greater networks, and better technological skills than their local staff (Hunt, 2015). Hence, nationality diversity within companies has increased considerably.

Therefore, our study makes several contributions. First, considering that firm innovation is a complex process associated with decision-making and that board independence alone may be insufficient, we go a step further and delve into the characteristics of independent directors. We propose that gender and nationality diversity among independent directors is the key to better understanding their role in firm innovation. As far as we know, we provide the first theoretical and empirical study to consider independent director diversity as a moderating variable between board independence and firm innovation. We use a sample of Spanish firms since the European context, and Spain in particular, offers a unique combination of elements that allows us to test our hypotheses.

Several European countries have implemented board diversity quotas for public companies, in order to promote public policy objectives such as increasing female participation in the labour market and female leadership, as well as encouraging better decision-making within firms (Griffin *et al.*, 2021; Makkonen *et al.*, 2018). Spain has been one of the first countries to regulate gender quotas and equality within the board of directors to foster gender equality in public and private firms (Girardone *et al.*, 2021); specifically, through the Unified Code of Corporate Governance CNMV (2020) [1] and the Equality Act of March 2007 [2] (De Anca and Gabaldon, 2014). Also, international agreements such as the Schengen Area and the European Union facilitate movement and trade among their signatory countries, making Europe one of the most globalized regions in the world, with a large number of companies reporting non-national board members (Staples, 2007). According to Eurostat data, the rate of foreigners immigrating to Spain, 9.9 per thousand inhabitants, exceeded the EU average of 4.3 in the year 2020. Furthermore, Law 14/2013, of September 27, on the promotion of entrepreneurs and their internationalization has been in force in Spain since 2013. This law provides for tax incentives to support research and development and technological innovation activities (Article 26). It also facilitates entry into Spain and residence for highly-qualified foreigners for training, research, development, and innovation purposes (Section 2 on international mobility, chapter 4 on highly qualified professionals). Therefore, our research in the Spanish context may be appropriate for explaining the role of independent directors' diversity (gender and nationality).

Second, we contribute to the debate on the role of independent directors in firm innovation. As the literature is not conclusive about the effect of the presence of independent directors on firm innovation, our research also attempts to contribute to this strand of the literature with new evidence for a European country. Specifically, we focus on Spain, a country with a continental financial system characterized by ownership concentration and block holders with strong board representation. The board of directors plays a key corporate governance

role in strategic decisions, with the independent directors also being in charge of protecting minority interests (Fernández-Temprano and Tejerina-Gaite, 2020) and they may also be a guarantee of firm decisions like firm innovation that may be perceived as highly risk by managers and large shareholders (Hernández *et al.*, 2010). Most previous studies on the relationship between independent directors and firm innovation have been carried out in countries with an Anglo-Saxon financial system, such as Australia (Valencia, 2018), US (Balsmeier *et al.*, 2017; Belkacemi *et al.*, 2021; Iyengar and Sundararajan, 2020; Jiraporn *et al.*, 2017; Li and Rainville, 2021; Lu and Wang, 2018; Tai *et al.*, 2018), UK (Garcia Osmá, 2008; Rodrigues *et al.*, 2020; Sena *et al.*, 2018), and Asia (Ashwin *et al.*, 2016; Berezinets *et al.*, 2019; Chen *et al.*, 2016; Chen and Hsu, 2009; Dong and Gou, 2010; Fu, 2019; Iren and Tee, 2018; Liao *et al.*, 2019; Shapiro *et al.*, 2015; Sharma *et al.*, 2018; Suman and Singh, 2020; Takahiro, 2015; Wang, 2021; Zhang, 2022). The empirical evidence for Europe is more limited (Attia *et al.*, 2021; Rossi and Cebula, 2015; Wincent *et al.*, 2012) and, as far as Spain is concerned, to our knowledge, there are only two studies: Gonzales-Bustos and Hernández-Lara (2014) and Gonzales-Bustos *et al.* (2020) [3].

Third, our results may serve as a guideline for policy makers and firms for structuring boards that are pro-innovation. In addition, they provide a new understanding for policy makers by highlighting how corporate governance recommendations seem to be an effective tool that encourages firms to continue reinforcing board diversity and independence as key aspects in strategic decisions.

Our findings from the data panel analyses carried out on 124 Spanish listed companies for the period 2008–2019 show that the presence of independent directors has a negative effect on firm innovation. However, this negative effect is reduced when there is greater gender and nationality diversity among the independent directors.

The rest of the paper is structured as follows. We first develop the theoretical framework and pose the hypotheses to be tested (section 2). We then describe the sample, the methodology used (section 3), and the results obtained (section 4). Finally, in section 5 we draw some conclusions and consider possible avenues for future research.

2. Research background and hypotheses

2.1 Independent directors and firm innovation

Firm innovation is a prerequisite not only for prolonging the existence and sustainability of firms but has also become a tool that leads to higher firm performance (Ahuja *et al.*, 2008; Hill and Snell, 1988). In this sense, firm innovation becomes one of the most desired goals for firm owners to ensure their long-term permanence in the market. As a result, there is intense competition among companies to create new products and services in the shortest possible time to keep up with the speed of market changes. However, the research and development process required to achieve new products and services is a long road, with many risks and no guarantee of positive results (Driver and Guedes, 2012). Thus, given the information asymmetry that innovation involves, managers are likely to opt for other types of less risky investment with immediate results. Agency problems in aligning interests between shareholders and management become evident (Fama, 1980; Fama and Jensen, 1983). From the perspective of agency theory, shareholders are interested in prolonging the legacy of their firms, while managers may seek to achieve the goals proposed in order to access incentive systems (Fama, 1980; Zona, 2016). As a consequence, the board of directors, and in particular its composition, may help to mitigate these agency problems (Hillman and Dalziel, 2003). The literature on corporate governance agrees that board composition plays an important role in innovation management (Ahuja *et al.*, 2008; Hill and Snell, 1988). Both inside and outside directors bring different criteria to the decision-making process (Barney, 1991; Dalziel *et al.*, 2011; Mahoney and Pandian, 1992). Inside directors know in depth the strengths

and weaknesses of the company due to their close relationship with it. They can also bring a deeper and more frank point of view on the real capabilities of the company and on which processes should be improved to innovate. Nonetheless, according to agency theory (Fama, 1980; Fama and Jensen, 1983), insiders' criteria can be affected by managerial opportunistic behaviour. Similarly, insiders may be influenced by myopia, that is, managers may prefer to focus on short-term investments that produce pay-offs quickly and may therefore be less likely to make long-term investments in, for example, innovation (Hermalin and Weisbach, 1988; Jiraporn *et al.*, 2017). As a consequence, it is recommended that external members should be included on the board of directors, especially independent directors who do not have any contractual relationship with the firm apart from the directorship (Fama and Jensen, 1983; Williamson, 1983).

Independent directors may reduce managerial discretion and entrenchment, thus avoiding manipulation of R&D investments (Garcia Osma, 2008) as they are less likely to accept opportunistic behaviour by managers. Consequently, they may be more effective in controlling and monitoring managers, and in minimizing agency problems. Similarly, at individual level, independent directors may be more interested in preserving their reputation and stricter in their control and supervision functions (Gu and Zhang, 2017). From the point of view of the theory of resources and capabilities (Grant, 1991; Mahoney and Pandian, 1992; Peteraf, 1993), each director can be a source of support and assistance in decision-making, mainly because innovation also requires identifying opportunities in the market, fast decisions and managing appropriate changes (Teece *et al.*, 2016). In this sense, the corporate governance literature highlights the role of independent directors as a valuable resource for firm innovation (Balsmeier *et al.*, 2017). The previous experience and knowledge of independent directors may provide different points of view, enabling them to better analyse opportunities for new projects (Lu and Wang, 2018). In addition, independent directors are likely to have links with other organizations, which might facilitate access to resources, partnerships or alliances outside the company and thus promote innovation (Hernández-Lara and Gonzales-Bustos, 2019). For example, an independent director sitting on the board of a technology firm, where innovation intensity is higher, may positively influence boards of other firms where innovation intensity is lower (Wu and Dong, 2021).

A large number of empirical studies support a positive effect of the presence of independent directors on firm innovation. For example, García-Sánchez *et al.* (2021), in their multi-country study of 321 companies from 2002 to 2017, find that independent directors promote eco-innovation and eco-design. As far as the US context is concerned, Balsmeier *et al.* (2017), using a sample of 713 companies, find that the firms with the most independent boards, patent and claim more and receive more total future citations on their patents. Also, in the American context, similar results are found by Atallah *et al.* (2021), Belkacemi *et al.* (2021), Lu and Wang (2018), and Tai *et al.* (2018).

Jiraporn *et al.* (2017) also find positive effects of independent directors on innovation in a study that includes 15,750 firm-year observations in Pakistan. There is also empirical evidence of a positive effect of independent directors in the case of Taiwan (Chen *et al.*, 2016; Chen and Hsu, 2009). These studies argue that R&D investment and R&D performance (patents) may increase when more independent directors are included in boardrooms. Similar positive effects are also found for the Chinese context in several studies such as Dong and Gou (2010), Fu (2019), Shapiro *et al.* (2015), Wang (2021) and Zhang (2022). Along the same line, Ashwin *et al.* (2016), Sharma *et al.* (2018) and Suman and Singh (2020) find that greater board independence improves innovation for Indian firms. These results are repeated in studies for other countries such as Japan (Takahiro, 2015), United Arab Emirates (Iren and Tee, 2018), and Russia (Berezinets *et al.*, 2019). In the European context, studies by Attia *et al.* (2021) for 120 French firms between 2002 and 2013, Rossi and Cebula (2015) for 41 Italian firms in the period 2005–2013 and Wincent *et al.* (2012) for 53 Swedish SME strategic

networks (period 2001–2006) also find that the presence of independent directors in boardrooms is beneficial for innovation. Finally, Sena *et al.* (2018) find that firms with independent boards tend to invest more in R&D and register more valuable patents in their study of 4,100 subsidiaries of UK multinationals located in 30 countries, considering 2005–2013 as the period of study. They find that independent directors are able to identify and restrict R&D cuts.

Based on previous arguments and empirical evidence, the following hypothesis is posed:

H1a. Board independence positively affects firm innovation.

However, other arguments suggest that independent directors play a limited role on the board. For example, the board's role as a monitoring and control mechanism for opportunistic managerial behaviour may be more effective in environments with low ownership concentration (Gutiérrez and Sáez, 2013). When shareholders do not accumulate sufficient power to monitor their managers, the presence of more independent directors may encourage the growth of R&D investments and reduce agency problems. However, in other environments with more concentrated ownership, such as family firms, shareholders play a leading role inside the firms as managers or board members. In these cases, the agency problems are not between shareholders and managers but between majority and minority shareholders (Chen *et al.*, 2016). In this context, independent directors might serve the interests of minority shareholders who may prefer to have dividends and short-term results rather than long-term results through innovation. Another potential problem in these circumstances is lack of cooperation by the majority owners who may not allow the independent directors to supervise their management when majority shareholders are also involved as managers or directors. This would generate a hostile environment between managers and the board with negative consequences for firm innovation.

Moreover, since they are not closely linked to the company, independent directors may not feel identified with the corporate objectives (Hill and Snell, 1988) and may therefore be likely to show less interest in long-term projects such as innovation. In addition, due to their independent status, they are likely to hold several positions in different companies, becoming busy directors (Ferris *et al.*, 2003; Fich and Shivdasani, 2006). This means they will not have much time to dedicate to each company, which will decrease their effectiveness in advice, control, and monitoring tasks (Gu and Zhang, 2016). Such multiple positions may also make it difficult to organize meetings and independent directors may even be absent for long periods, limiting information flows between shareholders, managers, and the board.

Some empirical studies confirm these arguments. Aihares (2020), for instance, finds a negative effect of independent directors on innovation intensity in his multi-country study of 12 countries. Jermias (2007) and Yousaf *et al.* (2019) find also that independent directors negatively moderate the relation between firm innovation and firm performance in their studies for Canadian and Pakistani firms, respectively. They argue that, when directors do not belong to the company, they do not know the internal processes and therefore are not in a good position to motivate managers to undertake profitable projects. Bliblech and Berraies (2018), in a study applied to top managers of Tunisian firms in 2017, conclude that independent directors' lack of knowledge of the complexity of the company's activities means they do not have an accurate criterion when it comes to adequately representing the interests of the shareholders. Li and Rainville (2021) report a negative relationship between independent directors and R&D in their study of US firms. They suggest that their findings may be an indicator that the conservative investment policies of independent directors when they have a military service background are a channel for lower innovation and lower firm performance. Wincent *et al.* (2012), based on a study of 53 Swedish firm networks (period 2001–2006), find that the presence of independent directors is positive for innovation projects, but only up to a certain point, after which it may be negative. More recently, in their study of

86 Spanish firms over the period 2003–2014, [Gonzales-Bustos et al. \(2020\)](#) found that independent directors have a negative impact on innovation and that this negative influence is even higher in family firms.

Based on the arguments and empirical evidence presented above, the following hypothesis is posed:

H1b. Board independence negatively affects firm innovation.

2.2 Diversity as a moderator of the relationship between independent directors and firm innovation

Board diversity as a tool to increase firm innovation has been the focus of several research studies over the last decades according to recent meta-analytical ([Makkonen, 2022](#); [Sierra-Morán et al., 2021](#)) and review studies ([Baker et al., 2020](#); [Khatib et al., 2021](#); [Roberson et al., 2017](#)) in the board of directors and firm innovation literature. Regarding the diversity of independent directors, previous studies underline the importance for firm innovation of independent directors having different backgrounds, such as education ([Li et al., 2020, 2021](#)), experiences, working styles, habits, contacts and so on, in order to increase diversity of opinions in boardrooms ([Attia et al., 2021](#); [Hernández-Lara et al., 2021](#); [Hsu et al., 2020](#)). In particular, as discussed below, both the specific qualities of female independent directors as well as the backgrounds of foreign independent directors may affect the initial relationship, to the extent that such diversity among the independent directors themselves (gender and nationality) may amplify their positive effect, given the increased quantity and quality of different points of view as well their connections outside the organization. Alternatively, independent director diversity might counterbalance the negative effect of independent directors by increasing their engagement and effectiveness within the firm.

2.2.1 Independent directors' gender diversity. Several factors may affect the way in which independent directors analyse and process information for decision-making. One of the characteristics highlighted in the literature is gender ([Miller and Triana, 2009](#)). According to recent studies, gender diversity within the boardroom is one of the topics in the literature that has been most extensively studied over the last three decades ([Khatib et al., 2021](#); [Sánchez-Teba et al., 2021](#)). Previous literature has studied the direct effect of the presence of female directors on both firm performance ([Cabeza-García et al., 2021](#); [Manita et al., 2020](#); [Post and Byron, 2015](#); [Terjesen et al., 2016](#)) and firm innovation ([Ain et al., 2021](#); [Attah-Boakye et al., 2020](#); [Cumming and Leung, 2021](#); [Mukarram et al., 2018](#); [Nadeem et al., 2020](#); [Rossi et al., 2017](#); [Saggesse and Sarto, 2019](#); [Töpfer, 2018](#); [Vafaei et al., 2020](#); [Valenti and Horner, 2020](#)), finding positive effects of their presence in boardrooms. The underlying arguments for these positive effects rely on specific qualities of a female director which may be a helpful contribution to the diversity of the whole board ([Arena et al., 2015](#); [Galia and Zenou, 2012](#); [Khan et al., 2021](#); [Saggesse et al., 2021](#); [Torchia et al., 2011](#)).

[Rejeb et al. \(2019\)](#), for instance, in a study applied to Tunisian companies found that board control, service and strategy activities are more favourable to innovation when boards are independent and when there is gender diversity on the board. Similarly, [Liao et al. \(2019\)](#) find a positive effect of the presence of female board members on innovation in their study of Chinese firms in 2017. [Chen et al. \(2018\)](#) carried out a study on a sample of Compustat and RiskMetrics companies and found that companies with female directors are more likely to invest in innovation and to obtain more patents and citations. [Chen et al. \(2021\)](#), in their study of US companies, reported that the positive effects on firm innovation of the presence of women in boardrooms are enhanced especially when they attend more board meetings. [Atallah et al. \(2021\)](#), in their study of US and Canadian firms, also report that the presence of women on boards is beneficial for both R&D investments and patents. In their study of firms

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creative, bring more input to new ideas and have the ability to help boards make better decisions related to innovation. In the same line, [Griffin et al. \(2021\)](#) carried out an extensive study with a sample of 12,244 companies from 45 countries around the world. Their results suggest that companies with greater board gender diversity achieve better management of corporate innovation (patents, patent citations and R&D expenditure).

In the European context, [Torchia et al. \(2011\)](#), based on a sample of 317 Norwegian companies, find that the level of innovation might improve when boards have at least three women to interact and influence the working style, processes and tasks of the board. [Galia and Zenou \(2012\)](#), in a survey of 176 French companies in 2008, find that gender diversity is positive for marketing innovation, but negative for product innovation [4]. Similarly, [Galia et al. \(2015\)](#) find a positive effect of board gender diversity on patents related to environmental aspects in their study of 142 firms also in France in 2008. For Spain, [Díaz-García et al. \(2013\)](#) analyse how board gender diversity influences radical firm innovation (new products) and incremental innovation (internal processes) based on a sample of 4,277 companies in 2007. Their findings suggest that board gender diversity is positively related to radical innovation. However, it has no significant effect on incremental innovation. [Hernández-Lara and González-Bustos \(2020\)](#) and [González-Bustos et al. \(2020\)](#) find that the presence of women on the board has a positive influence on innovation in their study of 86 Spanish firms for the periods 2003–2017 and 2003–2014, respectively. Finally, [Hernández-Lara et al. \(2021\)](#), in their study of 67 Spanish firms between 2003 and 2019, find a positive influence of female directors on firm innovation.

There are only a few studies in the literature on gender diversity on the board that delve into the condition of being both female directors who are also independent, especially regarding to innovation. [Terjesen et al. \(2016\)](#), for example, offer a tangential approach in their study regarding board independence related to firm performance moderated by gender diversity. They find that independent directors do not contribute to firm performance unless the board is gender-diverse. Similarly, [Hernández-Lara et al. \(2021\)](#) suggest that women's positive influence on firm innovation decreases if female directors have family ties to male board members. These ties diminish women's independence and effectiveness on the board. [Liao et al. \(2019\)](#) study the role of independent female directors in environmental innovation in their study of Chinese firms in 2017. They find a positive and direct effect of female independent directors on environmental patents. Their findings highlight the importance of independent status for female directors in the boardroom.

So, we propose that there might be differences between an inside female director and an independent female director. For example, while an inside female director may find it difficult to oppose the CEO's decisions because of her strong sense of loyalty to the company, a female board member who is also independent has the advantage of greater freedom to discuss ideas when she disagrees. Her loyalty will be more directly committed to the shareholders' interests ([Chen et al., 2018](#); [Liao et al., 2019](#)). Some characteristics and skills, such as willingness to share knowledge, attention to detail and sociability, can make independent female directors suitable for advising managers in decisions to innovate ([Nielsen and Huse, 2010](#); [Rejeb et al., 2019](#)). Moreover, the presence of independent female directors may facilitate the achievement of consensus in innovation decisions due to their conciliatory nature. This can avoid prolonged and unnecessary discussions. It is also likely that independent female directors will be used to working hard to enhance their own reputation as prestigious professionals and thus distinguish themselves in male-dominated environments ([Liao et al., 2019](#)). As their work might be questioned, they are likely to work harder to prove their worth to the board. Moreover, they may have been through rigorous selection processes before being positioned as female independent directors. This dedication and effort may be positive when creating new products.

In general, according to resource-based theory (Barney, 1991), the presence of (independent) female directors may directly influence firm innovation but at the same time may also help the independent directors' group to be more committed and effective in analysing new projects related to firm innovation (Torchia *et al.*, 2018). Thus, taking into account that the presence of independent directors may influence firm innovation, we consider the possibility that the impact of board independence on firm innovation might be stronger or weaker, i.e. might be moderated, depending on gender diversity among independent directors. Given the importance for women directors of establishing a successful relationship with the firm, they are likely to work harder on long-term strategies (such as innovation) by using their communication and cooperation skills to build or preserve their reputation in a male-dominated environment (Benkraiem *et al.*, 2021). Consequently, their high level of commitment may be reflected in more active participation in board activities such as meetings or committees, fostering board performance and increasing innovation (Hernández-Lara *et al.*, 2021).

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In addition, the presence of more independent women may encourage other, non-independent women to feel freer to express their opinions and contribute their ideas regarding the creation of new projects. It has also been shown that the combination of female owners with female high-level positions, for example, promotes the breadth of a firm's innovation, which in turn improves the value-added productivity of the firm (Azeem *et al.*, 2022). Moreover, women usually belong to a different social circle than men. Hence, they might provide a connection through these non-traditional ties to access financial or technological resources that are important for firm innovation (Cabeza-García *et al.*, 2021; Terjesen *et al.*, 2016). Furthermore, the communication, friendship and social skills of independent female directors may help to reduce communication barriers among the other independent directors, inside directors and managers. In this way, the flow of information, exchange of ideas, and access to new knowledge may lead to the creation of new products, processes, projects, etc.

In general, the presence of women among independent directors may promote and contribute to a suitable environment for making decisions. Their conciliatory nature as well as other personal characteristics (e.g. concern for their own reputation, attention to details, helpfulness, sociability, and consideration of stakeholders' needs) may moderate the effect of board independence on firm innovation. In particular, the presence of independent women may amplify the effectiveness of independent directors' control, monitoring and consulting activities related to strategic decisions such as innovation as well as the management of R&D investments. At the same time, female independent directors might help to decrease or counterbalance the negative effect on innovation of independent directors who are not motivated, do not know the firm's internal processes or do not feel sufficiently committed to the firm to support long-term projects (such as innovation) (Blibech and Berraies, 2018; Hill and Snell, 1988).

Based on these arguments, the following hypothesis is suggested:

H2. Gender diversity among independent directors moderates positively the relationship between board independence and firm innovation.

2.2.2 Independent directors' nationality diversity. The presence of different customs, cultures and experiences within the board is another aspect that may influence decisions made by independent directors on firm innovation. Nationality diversity within the board means a better mix of unique strategic resources, which helps firms to be more sensitive to environmental changes (Usman *et al.*, 2020). Some firms that are growing internationally recruit directors from other countries in order to ensure that they have the best and also generate new organizational structures complying with international canons (Staples, 2007). In addition, according to resource dependency theory (Pfeffer and Salancik, 1978), foreign

directors' links with international networks may be a valuable resource for firms, providing access to new investors (Makkonen *et al.*, 2018), which might also be positive for firms considering that innovation may be highly expensive (Baysinger *et al.*, 1991). When directors are also linked to both innovative start-ups and existing innovative firms, they raise the possibility of a two-way flow of knowledge between the companies (Baum *et al.*, 2022). In the case of foreign independent directors, these links could help the firm to grow thanks to their international background and experience (Lee *et al.*, 2012). Moreover, language, religion, family values and life experiences differ from one country to another. As a result, independent foreign directors are likely to react differently to situations in which they have to make risky decisions such as those related to innovation (Ararat *et al.*, 2015; Qi *et al.*, 2022).

The recruitment of foreign directors can help multinational firms to establish greater control over their subsidiaries in other countries (van Veen *et al.*, 2014). In addition, on a personal level foreign directors are likely to be more predisposed to change, a very important aspect in high-risk decisions such as innovation. Furthermore, boards with higher nationality diversity are more likely to have a broader view of the needs of the international market (Estélyi and Nisar, 2016) which may be beneficial for firm innovation. For example, foreigners may stimulate the development of products sold in their home country, but which are new in the local market and replicate their previous experiences (Attia *et al.*, 2021).

In terms of empirical evidence, there are not many studies that investigate the role of foreign directors related to firm innovation and even fewer relating to independent foreign directors. Miller and Triana (2009) study the relationship between racial diversity (Asian, Black, Hispanic, or White) and innovation in a study of 500 Fortune companies. Although they focus on the mediating effect of company reputation and innovation on the relationship between board diversity (race and gender) and firm performance, they find a positive relationship between board diversity (race and gender) and firm innovation. In the same US context, Cao *et al.* (2021) find that firms with more ethnic minority directors attract more productive ethnic minority inventors and promote greater collaboration among inventors, leading to more patents and patents with greater market value. However, the cultural distance between board members may be determined not so much by their race, but rather by their country of origin (van Veen *et al.*, 2014). For example, Usman *et al.* (2020), in their study of 11,250 firm-year observations of Chinese firms, find that the presence of foreigners strengthens the tendency to generate patents associated with green innovation.

There is also some evidence of positive effects of foreign directors in the European context. For instance, Makkonen *et al.* (2018), in research based on a large sample of 1,545,841 firms in 28 countries of the European Union in 2016, find a positive association between the presence of foreign directors and firm innovation. Similarly, Rossi and Cebula (2015) relate the presence of foreign directors to innovation in a study of 41 Italian firms in the period 2005–2013, finding positive effects. Attia *et al.* (2021), in their study of 120 French firms between 2002 and 2013, find also a positive effect of foreigners on R&D investments and on the creation of new products and services [5].

However, bringing foreign directors onto the board may have drawbacks for the company. Adapting to the local culture and to the new domicile, and language and communication barriers involve psychological factors that might require the foreigner to spend time adapting to the company and might lead to conflicts (Belkacemi *et al.*, 2021; Makkonen *et al.*, 2018). In addition, their presence in the firm as insiders would be partly determined by the CEO's decisions so, unlike local directors, foreign directors might further limit their criteria to be in line with the CEO's proposals. Nevertheless, when foreign directors are independent, they may have greater freedom of opinion when deciding on new, long-term projects. Sometimes, foreign independent directors may come from developed countries and their connections in such countries will make it possible to access resources abroad, such as foreign capital or new technologies. Hence, foreign independent directors have a more

globalized vision of international markets as well as experience in other environments, which may increase diversity of criteria among independent directors and information exchange within the boardroom (Staples, 2007; van Veen *et al.*, 2014), thus optimizing the effects of independent directors on firm innovation.

In addition, the presence of foreign independent directors from different cultures and with different customers is likely to change the attitude of other independent directors. The dynamism and participation of local independent directors might be increased when they are confronted with the effort of foreign independent directors to distinguish themselves within the group. Furthermore, the transfer of knowledge and organizational culture may help independent directors to be more critical, enrich their expertise and question their own ideas (Cao *et al.*, 2019). Along this line, the presence of foreign independent directors is likely to force local directors to investigate more about market trends in other countries, to learn more about cutting-edge technology, to avoid lagging behind and to step out of their comfort zone by diminishing their risk aversion. Conversely, this search for new knowledge might counterbalance the lack of interest and commitment of other independent directors, motivating them to learn more about the firm's internal processes as well as the demands of the environment in the design of long-term projects (such as innovation). Consequently, the brainstorming of new ideas within the boardroom is enhanced, promoting creativity and the development of new products.

Thus, similarly to gender diversity, we admit the possibility that the impact of board independence on firm innovation might be stronger or weaker, i.e. might be moderated, depending on nationality diversity among independent directors. The presence of foreign independent directors may amplify the positive effect of independent directors in their monitoring and supervisory tasks related to R&D investments, given their greater freedom to object when they disagree. Besides, their individual characteristics and international background may amplify access to resources, and their knowledge, experience, and predisposition to changes like innovation may reinforce or counterbalance the effect of board independence on firm innovation.

Based on these arguments, we present the following hypothesis:

H3. Nationality diversity among independent directors moderates positively the relationship between board independence and firm innovation.

F1 **Figure 1** shows the research model proposed in this study.

3. Empirical analysis

3.1 Sample

The database used to test the above hypotheses is made up of Spanish listed firms on the General Index of the Madrid Stock Exchange (IGBM) for the period 2008–2019 (175 companies, 1,396 observations). Financial and insurance firms were excluded from this initial database because of their special characteristics, such as their specificity from an accounting

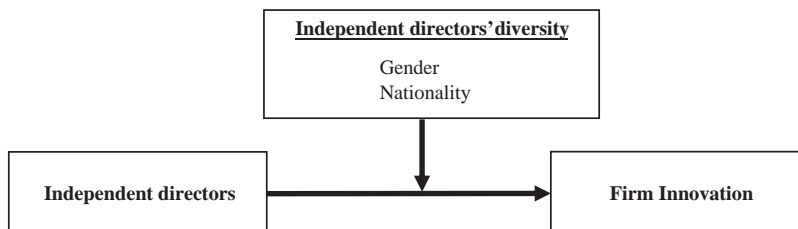


Figure 1.
Research model

point of view or because of the regulation or structure of this type of market (41 companies, 234 observations). This gave an initial sample 134 firms (1,162 observations). In addition to the previous filter, due to missing values in some of the variables considered, our final sample consists of an unbalanced panel of 988 observations from 124 Spanish listed companies for the period 2008–2019. 2008 was chosen as the starting year for our study as the Unified Code of Good Governance and the Equality Law of 2006 and 2007, respectively, seem to have initiated the path towards incorporating forms of positive discrimination for women on boards. The organic Law 3/2007, for the effective equality of women and men, recommends increasing the participation of women on the boards of directors of mercantile societies (article 75). The publication of this Law on March 22, 2007 allowed the Spanish stock market authorities (CNMV - *Comisión Nacional del Mercado de Valores*) to gradually increase the extent of gender diversity on the boards of directors of listed companies in the Unified Code of Good Governance of Listed Companies. For example, in its most current version (CNMV, 2020), not only is there a recommendation of gender diversity but also a minimum 40% quota from 2022 onwards.

As in some previous studies, the number of patents is considered as an innovation proxy (Chen *et al.*, 2016; Makkonen *et al.*, 2018). Information about firms' patents was obtained from the Espacenet database, developed by the European Patent Office (EPO) in collaboration with the member states of the European Patent Organization. Information on firms' boards of directors and board meetings was obtained from the annual corporate governance reports filed with the CNMV. Similarly, information regarding the educational background of directors was obtained from the annual corporate governance reports and from Google searches. Firms' financial information, including R&D expenses, sector of activity and number of employees, was obtained from the CNMV and from SABI (*Sociedad de Análisis de Balances Ibéricos*).

3.2 Measurement of variables

3.2.1 Dependent variable. Measuring firm innovation is complex, mainly because investing in R&D does not necessarily guarantee innovative results (Chen *et al.*, 2016; Dalziel *et al.*, 2011). Some firms may have invested large amounts of resources in projects without successful innovation results, so such projects were disregarded. On the contrary, the number of patents obtained reflects the verified innovation outputs. While R&D expenditures only capture observable innovation inputs, patenting activity reflects the firm's successful outputs after it has invested all observable and unobservable innovation inputs. Thus, patenting activity may be considered as a measure of innovation efficiency (Atallah *et al.*, 2021; Li and He, 2021). Additionally, previous studies (Ahuja and Katila, 2001; Chen *et al.*, 2016) argue that patents are closely related to the development of new products that imply a commercial value for the market and are also externally validated outcomes of innovation. Moreover, a link can be expected between firm patenting propensity and the products it ultimately brings to market (Ernst, 2001). Companies are likely to seek to patent inventions that show potential for commercial exploitation or lead to the development of new products (Artz *et al.*, 2010). In the same vein, the exploitation of patent rights implies short-term profitability and can contribute to higher, more persistent, and less volatile future profitability (Fitzgerald *et al.*, 2021; Hirshleifer *et al.*, 2018). Thus, in order to avoid R&D measurement problems, this study uses the number of patents obtained by the company over a year as a measure of firm innovation (PATENTS).

3.2.2 Explanatory variable. Board independence is measured as the number of independent directors over total directors (INDEP) (Blibech and Berraies, 2018; Lu and Wang, 2018).

3.2.3 Moderating variables. This study considers gender and nationality diversity among independent directors as moderating variables of the relationship between independent

directors and firm innovation. Gender diversity is measured as the number of independent female directors on the board over the total number of independent directors (WOM_DIVERSITY) (Liao *et al.*, 2019). Nationality diversity is operationalized as the number of foreign independent directors on the board over the total number of independent directors (NAT_DIVERSITY).

3.2.4 Control variables. We include board members' educational background and board meetings as control variables associated with the board. Educational background may increase the number of patents developed by a firm (Cumming and Leung, 2021; Sarto *et al.*, 2019). It was measured by checking the university degree of each independent director and dividing the total number of different degrees by the number of independent directors on the board. Business administration, finance or economics were considered in the same category as they are closely related to each other (EDU_BACKGROUND) (Fernández-Gago *et al.*, 2018; Sarto *et al.*, 2019). Regarding board meetings, these are considered the channel for the transmission of directors' knowledge and ideas that could potentially enhance firm innovation (Chen *et al.*, 2021). This variable was measured as the total number of board meetings in a year (MEETINGS) (Ain *et al.*, 2021; Torchia *et al.*, 2011).

In addition, we include other control variables associated with the firm. Research and development (R&D) is included because it may influence the number of patents that a firm can obtain annually (Balsmeier *et al.*, 2017; Shapiro *et al.*, 2015). It is defined as R&D expenditure (the sum of development, patents, licenses, and software applications included in annual reports) over the total number of employees in order to indicate the size of the company (Baysinger *et al.*, 1991; Hill and Snell, 1988). It is also controlled by the sector to which the company belongs as a dichotomous variable that takes the value of 1 if it belongs to the manufacturing sector and 0 otherwise (SECTOR). Firm age is measured as the logarithm of the years since the firm's creation (AGE) (Oehmichen *et al.*, 2017). Finally, a proxy of firm profitability is included (ROA) (Mukarram *et al.*, 2018).

3.3 Methodology

Following recommendations by Hilbe (2011) and Cameron and Trivedi (1990) as well as other previous research (Fich and Shivdasani, 2006; Liang *et al.*, 2013), an econometric counting model was used in view of the fact that the dependent variable PATENTS is a discrete variable with non-negative integer values. In other words, it is a question of determining how many patents a firm has generated, so such values cannot be negative or include decimal values. The Poisson regression model is usually used for analysis with count variables (Greene, 2012), but it is based on the assumption that the variance of the dependent variable is equal to the mean. When the variance value is higher than the mean, as in this study, there is overdispersion and a negative binomial regression model is more appropriate (Cameron and Trivedi, 1990; Hilbe, 2011). Random effects were used following Hilbe (2011, p. 487), who points out that "*random-effects estimators are more efficient than fixed-effects estimators when data are from a larger population of observations, as well as when there are more panels in the data*". In addition, and similar to Ashwin *et al.* (2015) and Liang *et al.* (2013), to control for a possible endogeneity problem in the proposed models, endogenous variables were lagged by one year.

Therefore, the general panel data negative binomial regression model used for the analysis is as follows:

$$\begin{aligned}
 PATENTS_{it} = & \beta_0 + \beta_1 INDEP_{it-1} + \beta_2 WOM_DIVERSITY_{it-1} + \beta_3 NAT_DIVERSITY_{it-1} \\
 & + \beta_4 INDEP_{it-1} \times WOM_DIVERSITY_{it-1} \\
 & + \beta_5 INDEP_{it-1} \times NAT_DIVERSITY_{it-1} + \beta_6 EDU_BACKGROUND_{it-1} \\
 & + \beta_7 MEETINGS_{it-1} + \beta_8 R\&D_{it-1} + \beta_9 SECTOR_{it} + \beta_{10} AGE_{it} + \beta_{11} ROA_{it-1} \\
 & + \sum_{t=2008}^{2019} Y_t + \epsilon_{it}
 \end{aligned}$$

where i refers to the firm, t to the time, $\sum_{t=2008}^{2019} Y_t$ is a set of time variables and ϵ is the error term.

In addition, to test our hypotheses, we performed a hierarchical regression analysis according to the moderation analysis procedure. Firstly, in Model 1 we included the control variables. In Model 2, together with the control variables, we considered the main explanatory variable (INDEP). In Models 3a and 3b, we added the respective moderating variables (WOM_DIVERSITY and NAT_DIVERSITY). In Models 4a and 4b, we included a new interaction variable resulting from the product of multiplying the main explanatory variable and by the moderating variables (INDEP x WOM_DIVERSITY and INDEP x NAT_DIVERSITY). Finally, in Model 5 we tested all the variables together.

4. Results

Table 1 shows the descriptive statistics and Table 2 shows the correlation matrix of the variables used in this study. Once the non-normality of the explanatory and continuous control variables was confirmed and considering the fact that Pearson’s correlation coefficient is not appropriate for discrete variables since it is very sensitive to violations of normality assumptions, Spearman’s rank correlations were calculated. Although some of the variables were significantly correlated, the analysis of the variance inflation factors (VIF) revealed no evidence of multicollinearity, as all of them remained under 10 (Kleinbaum *et al.*, 1988) and even under 5 (Hair *et al.*, 2010).

T1 T2

Variable	Mean	Min	Max	St. Dev.
Panel A: Continuous variables				
PATENTS	2.589	0	153	10.356
INDEP	39.585	5.556	100	16.390
WOM_DIVERSITY	18.727	0	100	23.092
NAT_DIVERSITY	11.104	0	100	20.516
EDU_BACKGROUND	64.866	16.667	100	23.097
MEETINGS	10.361	0	42	3.819
R&D	94.013	0	4,727.672	276.898
AGE	46.270	1	142	27.970
ROA	0.035	-1.937	0.728	0.126
Panel B: Dummy variables				
SECTOR			318 (32.19)	
Note(s): $n = 988$				

Table 1.
Descriptive statistics

AQ: 11

Variable	1	2	3	4	5	6	7	8	9	10
1. PATENTS	1									
2. INDEP	0.169***	1								
3. WOM_DIVERSITY	0.143***	0.226***	1							
4. NAT_DIVERSITY	0.174***	0.240***	0.132***	1						
5. EDU_BACKGROUND	-0.150***	-0.401***	-0.201***	-0.146***	1					
6. MEETINGS	0.010	-0.100***	0.092***	-0.072**	0.026	1				
7. R&D	0.231***	0.156***	0.136***	0.250***	-0.165***	0.086***	1			
8. SECTOR	-0.055*	-0.163***	0.004	-0.271***	0.140***	-0.130***	-0.077**	1		
9. AGE	0.151***	-0.125***	-0.088***	-0.214***	-0.067**	0.112***	-0.090***	0.275***	1	
10. ROA	0.126***	0.155***	0.098***	0.116***	-0.165***	-0.135***	0.047	-0.056*	-0.018	1

Note(s): $n = 988$

* $p < 0.10$; ** $p < 0.05$; *** $p < 0.01$

Independent
directors and
firm innovation

Table 2.
Correlation matrix

Table 3 shows the results of the panel data negative binomial analysis following the moderation procedure. Model 1 presents the effects of the control variables on firm innovation. Model 2 includes the main explanatory variable, percentage of independent directors, and the control variables. A significant negative effect of independent directors on firm innovation (number of patents) was found (at a 1% level), confirming the existence of a negative relationship between independent directors and innovation, as stated in Hypothesis 1b. These findings contradict the arguments based on agency theory (Fama, 1980; Fama and Jensen, 1983) and those of previous studies which suggest that the role of independent directors is mainly to prevent and reduce opportunistic behaviour by managers and to increase innovation (Balsmeier *et al.*, 2017; García-Sánchez *et al.*, 2021; Lu and Wang, 2018; Zhang, 2022). Our results suggest that being independent is not a guarantee of better decision-making performance when it comes to innovation-related decisions. It is likely that by not feeling involved with the firm, they do not feel sufficiently committed to support new research and development projects. Alternatively, too many positions on other boards are likely to limit the time available for independent directors to devote to each firm, diminishing their effectiveness in advisory, monitoring, and supervisory tasks (Gu and Zhang, 2016). Our findings are consistent with studies in other contexts like AlHares (2020) in a multi-country study based on a sample of 12 countries (period 2010–2016), which finds that the presence of independent directors reduces R&D investments. Similarly, our results are in line with the findings of Blibech and Berraies (2018) in their study of 60 Tunisian firms in 2017. They conclude that due to lack of knowledge of the firm's internal processes, the criteria of independent directors are not effective for making decisions related to firm innovation. Similarly, other studies find that independent directors decrease the relationship between R&D spending and firm performance, such as those by Jermias (2007) for 274 Canadian firms between 1997 and 2001, and Yousaf *et al.* (2019) in a sample of 27 firms in Pakistan (period 2009–2016). Likewise, our results correspond with those of González-Bustos *et al.* (2020) based on 86 firms over the period 2003–2014 in the Spanish context.

In Models 3a and 3b, the moderating variables of gender, and nationality diversity were added respectively. They showed that gender diversity among independent directors has a positive and statistically significant effect on firm innovation (Model 3a). These results confirm that the specific characteristics associated with the presence of women in boardrooms (creativity, commitment, etc.) are conducive to increased patenting, especially when they are also independent. These findings are in line with those of Atallah *et al.* (2021), Chen *et al.* (2018), Griffin *et al.* (2021) and Liao *et al.* (2019) in different contexts around the world. Our results also corroborate previous studies for the Spanish context during the 2000 decade, such as Hernández-Lara and González-Bustos (2020), Hernández-Lara *et al.* (2021) and González-Bustos *et al.* (2020). However, contrary to Makkonen *et al.* (2018) in their multi-country study (28 EU countries) in 2016 and Rossi and Cebula (2015) for 41 Italian firms, period 2005–2013, nationality diversity (Model 3b) does not have a significant effect on patents.

In Models 4a and 4b, the interactive variables were added, that is, the percentage of independent directors multiplied by the proxies of independent directors' diversity. The term of interaction (INDEPxWOM_DIVERSITY) in Model 4a is positive and significant (at 5% level), supporting Hypothesis 2. These results confirm that gender diversity among independent directors improves the fluidity of information exchange and cooperation between independent directors and other board members, decreasing the negative effect of independent board members on firm innovation. Moreover, our findings are in line with the resource-based theory (Barney, 1991) and resource dependence theory (Pfeffer and Salancik, 1978), which considers the presence of independent female directors as a source of valuable advice among independent directors. Similarly, the interactive variable (INDEPxNAT_DIVERSITY) in Model 4b is also positive and statistically significant at 1%, in line with Hypothesis 3. These results also suggest

Independent variables	Model 1	Model 2	Model 3a	Model 3b	Model 4a	Model 4b	Model 5
Constant	0.451(0.43)	1.694(1.47)	0.711(0.61)	1.500(1.28)	1.021(0.89)	1.618(1.33)	0.934(0.78)
INDEP		-0.019***(-4.28)	-0.016***(-3.81)	-0.018***(-3.99)	-0.025***(-4.41)	-0.022***(-4.50)	-0.026***(-4.35)
WOM_DIVERSITY			0.010***(3.42)		-0.002(-0.37)		3.14e-05(0.01)
NAT_DIVERSITY				0.002(0.84)		-0.009*(-1.74)	-0.009(-1.57)
INDEP x NAT_DIVERSITY					3.72e-04***(2.35)		2.99e-04*(1.83)
INDEP x NAT_DIVERSITY						3.69e-04****(2.81)	3.12e-04***(2.27)
EDU_BACKGROUND	0.006***(2.11)	0.002(0.86)	0.003(0.99)	0.002(0.83)	0.002(0.53)	0.003(1.02)	0.002(0.73)
MEETINGS	-0.010(-0.58)	0.009(0.65)	0.016(1.27)	0.009(0.65)	0.017(1.44)	0.016(1.22)	0.021*(1.82)
R&D	4.65e-05(0.10)	-9.66e-05(-0.20)	-1.54e-04(-0.31)	-1.43e-04(-0.29)	-2.18e-04(-0.42)	-3.49e-04(-0.68)	-4.44e-04(-0.82)
SECTOR	-0.037(-1.08)	-0.062*(-1.91)	-0.067**(-2.02)	-0.061*(-1.86)	-0.059*(-1.75)	-0.048(-1.47)	-0.048(-1.43)
AGE	0.153(0.61)	0.171(0.64)	0.300(1.13)	0.199(0.74)	0.296(1.14)	0.161(0.58)	0.288(1.07)
ROA	0.209(0.23)	0.278(0.32)	0.183(0.22)	0.252(0.29)	-0.056(-0.07)	0.202(0.24)	-0.064(-0.08)
Annual effect considered	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Wald χ^2	16.15	37.76***	53.82***	39.03***	58.09***	46.91***	63.67***
Log likelihood	-983.906	-974.832	-969.246	-974.485	-966.471	-970.604	-963.791
LR test rho = 0	725.68***	728.12***	728.04***	704.24***	732.58***	704.93***	707.13***
z_1	6.23	25.68***	41.03***	26.69***	45.45***	34.16***	50.51***
z_2	11.29	16.42*	15.88	15.47	15.13	17.44*	17.97*

Note(s): t -value are shown between parentheses
Number of observations = 988 Number of groups = 124
 z_1 is a Wald test for the reported coefficients of the explanatory and control variables, asymptotically distributed as χ^2 under the null of no relationship for all the explanatory variables. z_2 is a Wald test for the reported coefficients of the dummy annual variables, asymptotically distributed as χ^2 under the null of no relationship for all the explanatory variables
*** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$

Table 3.
Negative binomial regression results

that the presence of foreign independent directors is likely to help the other independent directors to have a broader vision and to come up with new ideas for new products and patents. Such findings are probably closer to resource and capability theory (Grant, 1991; Mahoney and Pandian, 1992; Peteraf, 1993), which argues that the specific characteristics of each director may be a source of support, diversity criteria and assistance in decision-making, especially in decisions associated with innovation. Finally, Model 5 includes the complete model with all the variables and confirms the above results. As a whole, there seems to be evidence of a moderating effect of gender diversity ($\beta = 2.99e-04$, p -value 0.068) and nationality diversity ($\beta = 3.12e-04$, p -value 0.023) among independent directors on the relationship between board independence and firm innovation. Our results therefore provide evidence that the gender and nationality diversity of independent directors is key to better understanding the role of the latter in relation to firm innovation. Additionally, gender diversity among independent directors can be considered a quasi-moderator, given that it has both direct and moderating effects on firm innovation. Nationality diversity among independent directors is a pure moderator since the only effect found is moderation. In any case, both moderating variables can be said to affect the form and strength of the relationship between independent directors and firm innovation (Sharma *et al.*, 1981).

In relation to the control variables, it can be seen that SECTOR has a negative and significant effect in models 2, 3a, 3b and 4a, with patterns of sectorial innovation varying from one sector to another (García-Piqueres *et al.*, 2016). In other words, it is likely that service firms innovate more than manufacturing firms, due to the knowledge-intensive trend in which human capital and services firms, in particular, play an important role as knowledge brokers and intermediaries (Hipp and Grupp, 2005). Furthermore, it is evident the growth in the market of service firms that have realized the importance of innovation in business progress and seek their own innovative development (Kong *et al.*, 2021). Thus, it can be said that the increasing digitalization of industrial processes has led to the creation of new technological service companies (Sarbu, 2021) which develop new services that can be patented. Regarding the MEETINGS variable, this has a positive effect on firm innovation only in model 5. This result suggests that a higher frequency of board meetings is likely to be an indication of a board that is more engaged in its functions, including decisions related to innovation, as suggested by Berezinets *et al.* (2019) in their study of 183 firms in Russia over the period 2011 and 2013. Finally, no significant results are found for EDU_BACKGROUND, R&D, AGE and ROA variables on firm innovation.

Figures 2 and 3 were plotted following Dawson's (2014) instructions. They show the interactions of both gender and nationality diversity respectively and give a better

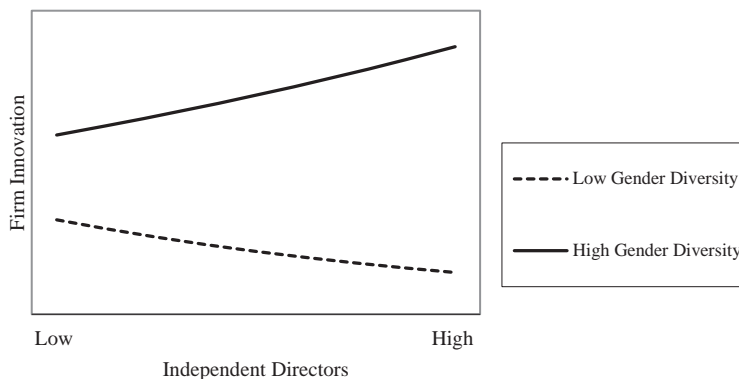


Figure 2.
Independent directors and firm innovation: the role of independent's gender diversity

explanation of the effects they obtain in the negative binomial analysis. It can be seen that low gender and nationality diversity among independent directors can diminish firm innovation. On the other hand, when there is greater gender and nationality diversity among independent directors, there is a marked increase in innovation.

We also repeated the models with different proxies for some control variables and with other methodology to verify the robustness of the results. The results remain the same if EDU_BACKGROUND is measured using the Blau index. For this purpose, we classified the university degrees of independent directors into six related categories. Additionally, we found that, when ROA is changed to ROE, the results do not vary. Similarly, results are not affected by eliminating the R&D variable from the models, slightly modifying the R&D proxy (the sum of development, patents, licenses over the total number of employees), or when R&D is divided by total assets or total sales instead of by the number of employees. Similar results are also obtained when the number of patents lagged by one year is added as a control variable. In addition, results remain the same if, instead of classifying firms as manufacturing and non-manufacturing (SECTOR variable), we classify them according to OECD technology-intensive sectors (high, medium, and low technology). We also repeated the analyses by including together in the models the two proxy variables related to sector (type of activity and technological opportunity of the sector) and the results did not change. Finally, we repeated the negative binomial model with fixed effects, and the results remain the same but with a decrease in the sample size (539 observations from 57 firms).

5. Discussion and conclusions

Board independence has been widely recommended in most studies on corporate governance and innovation (Balsmeier *et al.*, 2017; Fama and Jensen, 1983; Garcia Osma, 2008; Lu and Wang, 2018). However, there is still no consensus from either the theoretical or empirical points of view on the effect of independent directors on firm innovation. Consequently, our study contributes to the literature on corporate governance and firm innovation with new evidence from the European context, which has not yet been thoroughly investigated (Attia *et al.*, 2021; Rossi and Cebula, 2015; Wincent *et al.*, 2012). Based on Spanish listed companies over the period 2008–2019, we contribute to the literature with a new perspective that has not been considered before. We propose that the presence of independent directors on the board is not enough in itself to explain their role in firm innovation. Therefore, we explore how diversity (gender and nationality) among independent directors may explain their relationship with firm innovation. Specifically, we analyse the effect of board independence on innovation and how independent directors' gender and nationality diversity moderates this relationship.

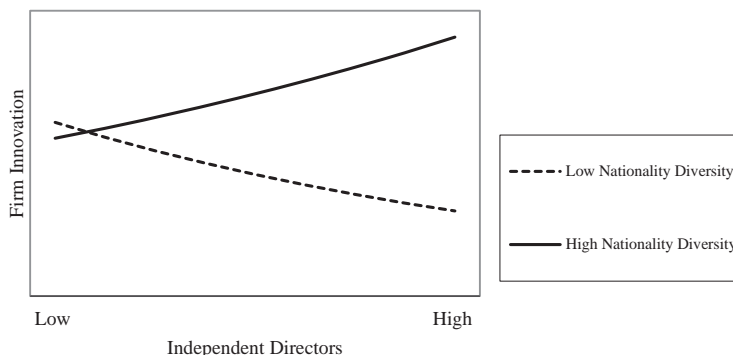


Figure 3.
Independent directors
and firm innovation:
the role of
independent's
nationality diversity

Using a panel data methodology, our findings suggest a negative effect of independent board members on firm innovation. There are three possible reasons for this result. First, monitoring and control activities of independent directors are less effective in environments with high ownership concentration as in Europe (Gutiérrez and Sáez, 2013). Second, it is likely that independent directors, due to the lack of a strong nexus and company knowledge, do not feel motivated enough to support long-term strategies, such as innovation (Blibech and Berraies, 2018; Hill and Snell, 1988). Third, insufficient dedication, due to the multiple positions independent directors often hold in different companies, may reduce the quality and effectiveness of their work as directors (Ferris *et al.*, 2003; Fich and Shivdasani, 2006). Hence, it is important not only to include independent directors on the board but also to ensure they have sufficient commitment and time to perform their tasks within the board.

Regarding independent directors' gender diversity, we found an effect of quasi-moderation, that is, there is a direct positive effect on innovation (Sharma *et al.*, 1981) as well as a positive moderation effect on the initial negative relationship between independent directors and firm innovation. In other words, gender diversity among independent directors has two effects. First, the presence of female independent directors may increase the likelihood of obtaining new patents. Second, the presence of female independent directors in the boardroom may also strengthen the independent directors' sense of commitment and dedication to innovate, and as a result, the negative effect of independent directors on firm innovation might be reduced. This result shows that male and female points of view complement each other and contribute to improving the quality of decisions on innovation made by the board. Our findings are in line with resource-based theory (Barney, 1991) and resource dependency theory (Pfeffer and Salancik, 1978), confirming the dual role of independent female directors as an internal resource for the firm and as a bridge to accessing resources from the environment to enhance firm innovation (Attah-Boakye *et al.*, 2020; Makkonen *et al.*, 2018). Additionally, our results complement previous studies that find the presence of women on the board beneficial for innovation (e.g. Ain *et al.*, 2021; Attia *et al.*, 2021; Gonzales-Bustos *et al.*, 2020; Hernández-Lara *et al.*, 2021; Hernández-Lara and Gonzales-Bustos, 2020; Miller and Triana, 2009; Mukarram *et al.*, 2018; Vafaei *et al.*, 2020) and contribute to this branch of research with regard to the introduction of gender diversity. Our study shows that gender diversity is desirable not only on the board as a whole but also among independent directors to ensure effective results (both direct and moderating) in decisions on innovation.

As far as nationality diversity among independent directors is concerned, this has a pure positive moderating effect. In other words, independent directors' nationality diversity may mitigate the negative effect of board independence on firm innovation but does not have a direct effect on firm innovation. These results suggest that the role of independent directors is close to the resource dependency theory (Barney, 1991), that is, they facilitate connections outside the organization (Ferreira *et al.*, 2020; Hillman and Dalziel, 2003; Teece *et al.*, 1997). The knowledge and experience gained by foreign independent directors in other environments is a valuable resource for companies (Rossi and Cebula, 2015). However, it is likely that such qualities will be beneficial to firms only when foreign independent directors are able to influence the behaviour of other independent directors regarding innovation. Otherwise, their ideas may be limited by the presence of a majority of local directors. In addition, since innovation might require large investments, the presence of foreign independent directors might be beneficial for innovation because of their links with other markets and consequent access to resources (Attia *et al.*, 2021; Cebula and Rossi, 2015; Makkonen *et al.*, 2018; Rossi and Cebula, 2015; Usman *et al.*, 2020), which can counterbalance the negative effect of board independence on firm innovation. Moreover, foreign independent directors are likely to have experience in other capital markets that are more advanced and with stronger shareholder rights (Ararat *et al.*, 2015; Lee *et al.*, 2012). They can therefore

exercise the monitoring function better to both protect their reputation (Lee *et al.*, 2012) and support innovation projects as part of the corporate strategy.

This study points to a negative effect of independent directors on firm innovation, that is, the presence of independent directors on the board in itself seems to be negative for firm innovation. However, when independent directors are sufficiently diverse in terms of gender and nationality, such negative effects on firm innovation may be reduced. In this way, we contribute to the literature by pointing out that diversity, particularly gender or nationality diversity, among independent board members is important when making decisions (Bianchi *et al.*, 2012; Midavaine *et al.*, 2016).

As a consequence, there are important implications for firms arising from this study. Our findings may help firms to identify some characteristics of independent directors that increase firm innovation. Firms should consider other aspects of independent directors apart from the fact that they have no direct links with the firm. Ideally, firms should focus on independent director diversity in order to optimize the role of such independent directors and increase diversity of criteria in the boardroom, thus improving the board's performance in strategic decisions, such as innovation. In particular, our results highlight that gender and nationality diversity within boards may help firms to break the stereotype of "old (white) boys networks" (Villesèche and Sinani, 2021) and increase opportunities to turn them into competitive advantages, enhancing firm innovation and performance, in line with previous studies.

Moreover, our research also emphasizes the fact that gender diversity not only increases board engagement and performance but can also benefit firm innovation. The presence of independent female directors increases the commitment and cooperation of independent directors and decreases their negative effect on firm innovation. This argument offers evidence to organizations that contributing to women's empowerment at high-level positions (for example, on boards of directors) not only reflects an organizations' commitment to equal opportunity norms but can also increase its innovative capacity. However, although gender and nationality diversity on boards of directors is a global issue of interest to countries and firms, changes within boards are still falling short of expectations. In this sense, our study contributes to previous research suggesting that board diversity should be increased (Cabeza-García *et al.*, 2021; Miller and Triana, 2009; Terjesen *et al.*, 2016). Our study may also offer information to multinational companies that send their local employees as board members to their subsidiaries in other countries (Staples, 2007). Empirical evidence suggests that the presence of foreign directors may reduce the negative effect of local independent directors as long as such foreign directors are also independent and have sufficient autonomy to present their proposals. Their contribution is probably beneficial because they increase diversity of criteria on the board when decisions related to innovation are considered. Additionally, our findings suggest that the implementation of inclusion and equity policies by government authorities would be positive for firm innovation.

Finally, following the call of previous literature (Khatib *et al.*, 2021; Ruijgrok *et al.*, 2007), our study presents evidence of diversity interaction within the board. Hence, we encourage public and private organizations to consider further incentives and policies to increase diversity in the boardroom, specifically among independent directors. Increasing the nationality and gender diversity of independent directors is not only a signal to the market (investors, customers, etc.) of the organisation's commitment to the values of equality and inclusion but also brings benefits for decision-making on innovation.

It is necessary to acknowledge as a shortcoming of the study that the problem of endogeneity might not have been fully removed by employing lagged independent variables. In addition, the context of the study should be mentioned as a limitation; although Spain provides evidence on the European situation, the database corresponds to only one country, so generalization of the findings to other countries is limited. A multi-country study should be

performed so that results can be applied to other environments. Second, our study focuses on one proxy of output innovation (patents) to measure innovation. However, it might be recommendable for future research to include other proxies of innovation, like patent citations, patent forward citations, citation-weighted patent count, in order to make the results more robust. Third, it would also be interesting to analyse whether other kinds of diversity (e.g. professional experience in other industries, age and previous training) could influence the relationship between independent directors and the generation of patents. Similarly, other aspects could be included as possible moderators, such as CEO duality, independent directors' tenure, or board interlocks.

Notes

1. The 2015 Unified Code of Good Governance (updated in June 2020), in its recommendation No. 15, suggests that female directors should represent at least 40% of board members before the end of 2022 and onwards, not being less than 30% before.
2. Organic Law 3/2007 for the effective equality of women and men (Article 75) recommended that firms listed on IBEX 35 (the Spanish stock exchange reference index) and firms with more than 250 employees should include a 40% quota of women on their boards before 2015, with incentives for companies that comply (De Anca and Gabaldon, 2014).
3. Gonzales-Bustos and Hernández-Lara (2014) is a descriptive study for 86 firms from 2003 to 2011 while Gonzales-Bustos *et al.* (2020) analyse the effect of some board characteristics (size, gender, duality, and independence) on firm innovation, differentiating between family and non-family firms, for a sample of 86 firms over the period 2003–2014. However, these studies do not delve into the specific characteristics of independent directors.
4. Conversely, AlHares *et al.* (2020), García-Sánchez *et al.* (2021), Almor *et al.* (2022) and Rossi and Cebula (2015) find a negative effect of the presence of female directors on firm innovation. Other studies do not find significant effects of the presence of gender diversity on R&D investments (Atinc *et al.*, 2021; Benkraiem *et al.*, 2021; Bianchi *et al.*, 2012; Iren and Tee, 2018; Sila *et al.*, 2016; Suman and Singh, 2020) or patent generation (Tseng *et al.*, 2013).
5. In contrast, other studies find a negative effect of nationality diversity (Khan *et al.*, 2021) or of cultural diversity (Belkacemi *et al.*, 2021) on firm innovation.

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AQ: 12 **Further reading**

Rahman, D., Faff, R. and Oliver, B. (2021), "Does board independence constrain insider opportunism?", *Australian Journal of Management*, Vol. 46 No. 3, pp. 499-522.

Independent
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